ICC Dresden abstract

Dynamics and Entropy of Land Use Changes of Metropolitan Areas in Poland (abstract)
Land use is defined as the spatial distribution of forms of land cover patches utilized or unutilized by human within the framework of spatial and mutual relationships.
The term refers to a given terrain's functional character and is identified with a socio-economic description of the surface (Ciołkosz & Bielecka, 2005).
The observed dependency of land use and neighbouring land cover patches is discussed in many geography and spatial economy publications i.e. the economic utilization of an observed lot (or patch) has significantly less implications for its future utilisation than the existing land use in its neighborhood. Factors stimulating further land use changes include the existing neighbouring land use or the predominant land use type in a given region (Hagoort, 2006).
The advancement of GIS has facilitated simulations and geovisualizations of results of spatial analysis of land use.
The majority of analyses confronted two categories of factors influencing the observed land use changes and, at their core, involved an evaluation of spatial changes which resulted from the impact of neighbouring and consecutive forms of land use in a given area.
The types of land use classes differed depending on the aim, the scale and the area of an individual geographical study.
The changes in land use can be treated as a complex and (to an extent) random process. The research aims included the formulation of a theoretical structure of the neighborhood coefficients (Werner, 2009), analysing their operationalization and verifying their practical application.
Cellular automata are mathematical models for complex natural systems containing large numbers of simple identical components with local interactions.
The concept of neighborhood coefficients is based on the combination of map algebra with two-dimensional cellular automata.
The NBC is calculated on the basis of a mathematical formula (Eq.1) which contains the numbers describing land use classes and the consecutive numbers of the cells in Moore neighborhood (3x3).

$$NBC_c = \sum_{i=0}^{8} k_i n^i$$
$$\text{where } k \in \{0,1, \ldots, n\} \text{ (Eq.1)}$$

The NBC is reversible. It is therefore possible to reconstruct (recalculate) the original input land use classes in Moore neighborhood (their nominal numbers) on the basis of the value of the central cell's NBC (Eq.2).

$$k_i = (\text{quotient } (NBC_c/(n^i))) \bmod n$$
$$\text{where } k \in \{0,1, \ldots, n\} \text{ (Eq.2)}$$

These above formal constructions serve as the starting point to evaluate the spatio-temporal processes of the changes of spatial differentiation of land use changes in Metropolitan Areas in Poland using the entropy formula. The proposed approach lets to present statistical estimation and makes possible of uniform comparative studies of land use changes of metropolises in Poland and simultaneously cartographical visualizations of locations and details of dynamics of land use changes.
The verified hypothesis concerns the first assumption of the growing entropy of particular metropolises as the whole units and their internal spatial differentiation. The second assumption states that there are uniform stable core urbanized areas (zero entropy) which in fact are not changing with time.
Entropy is a continuous function of non-negative values, independent of the alternation of components. The values in the range $[0, \log_2 N]$; a value of 0 when there is a total share of only one element, and the maximum value in the case of common shares equal to all elements of the structure (the most diverse land use). Shannon's entropy formula has been used.

The idea laid along the research is the observation of Batty (2008): “Cities are . . . par excellence complex systems: emergent, far from equilibrium, requiring enormous energies to maintain themselves, displaying patterns of inequality spawned through agglomeration and intense competition for space, and saturated flow systems that use capacity in what appear to be barely sustainable but paradoxically resilient networks.”

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